EUB

BP Canada Energy Company
Ethane Cavern Well Fires
Fort Saskatchewan, Alberta
August/September 2001

EUB Post-Incident Report
April 2002

Alberta Energy and Utilities Board

102-05657/

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Executive Summary

BP Canada Energy Company (BP) operates a natural gas liquids (NGL) plant located about 6 kilometres northeast of Fort Saskatchewan, Alberta. NGL products are stored on site and delivered through pipelines to a number of locations in Alberta, eastern Canada, and the United States. This facility plays a significant role in the Alberta NGL pipeline network.

On August 26, 2001, an elbow failed on a 2-inch (60.3 millimetre) line connecting two wellheads that service one of the storage caverns. The EUB is satisfied that unusual transverse forging defects caused the elbow to fail. These defects would not be detectable through conventional testing methods. The failure of this elbow resulted in ethane product being released to atmosphere, creating an ethane vapour "plume" that ignited through contact with overhead power lines located on the plant site.

There were no injuries to plant personnel, and all access roads to and from the plant were immediately secured. BP activated its emergency response plan and shut down the facility. Black smoke from the fire was significant and observable for many kilometres away. Although this incident generated significant interest from the media and general public, there was no threat to members of the public or their property.

From the first day of the incident, officials from the Alberta Energy and Utilities Board (EUB) and Alberta Environment worked closely with local authorities and BP operations staff to coordinate actions and expedite well control operations. The fire was contained within the BP plant site. Environmental impacts of the incident were primarily emissions of soot and other particulate matter from the fire in the early stages. Air samplings indicated that provincial air quality guidelines were not exceeded. The fire at the plant site continued to burn in a decreasing manner until September 3. In the days immediately following, most plant and pipeline operations, except those involving the wells, pipelines, and ethane storage cavern directly associated with the incident, resumed normal operations.

When the fire began, local emergency response personnel assessed the situation and determined that there was no danger to the general public. The EUB agrees with this assessment and believes that BP, the City of Fort Saskatchewan, and other local emergency response personnel reacted quickly to the situation and carried out their emergency response responsibilities in an appropriate manner. However, it is clear from public feedback that early public notification of this incident did not meet public expectations. Therefore, some improvements to early communication processes involving local residents are warranted in any future responses from BP or other operators in the area experiencing an incident of similar high visibility.

At the time of issuing this report, BP's ethane storage cavern is out of operation and will remain so until approval to resume operations is granted by the EUB. The EUB notes that BP staff cooperated fully and openly with local and provincial authorities from the beginning of this incident and throughout the investigation led by the EUB. Since the incident, equipment design changes carried out by BP effectively ensure that a similar incident will not recur. In addition, the EUB intends to advance a regulatory change requiring an approved emergency response plan for all NGL cavern storage facilities, including effective ignition criteria.

1 Purpose and Scope of Report

This report summarizes the Alberta Energy and Utilities Board (EUB) findings concerning the BP Canada Energy Company (BP) ethane cavern well fires, providing all stakeholders with a common frame of reference for EUB conclusions and associated recommendations and actions taken to prevent a recurrence.

EUB post-incident investigations are aimed at ensuring that

- information pertaining to the incident is analyzed,
- the root cause of the problem is identified and understood, and
- as far as possible, corrective actions regarding design standards and operating practices are implemented to prevent a similar occurrence.

2 Incident Overview

BP operates a natural gas liquids (NGL) plant located about 6 kilometres northeast of Fort Saskatchewan, Alberta (see Figure 1). NGL products are stored on site and delivered through pipelines to a number of locations in Alberta, eastern Canada, and the United States. This facility plays a significant role in the Alberta NGL pipeline network.

On August 26, 2001, an elbow failed on a 2-inch (60.3 millimetre) line connecting two wellheads that service one of the storage caverns (see Figure 2). The failure of this line caused a vapour release of ethane that caught fire approximately 2 hours after the initial failure. The fire was put out on September 3, 2001. In total, it is estimated that about 14 500 cubic metres (m^3) of ethane product was lost during this incident.

2.1 Chronology of Events on August 26, 2001

Cavern 103 Operations and First Alarm Notification

- In the early morning hours on August 26, 2001, ethane was being pumped up well 103 by displacing the ethane in the storage cavern with brine injected into well 103A. Wells 103 and 103A are about 20 m apart.
- Just after 7:00 a.m., BP's main control room at the Fort Saskatchewan plant site received an alarm from the cavern 103 gas detector analyzer, and shortly thereafter the control room recorded another alarm from another gas detector in the area.
- BP staff then observed a vapour cloud in the area above cavern 103 facilities. Cavern 103 was shut in.

7:10 a.m. to 7:50 a.m.

- BP shut in its Fort Saskatchewan NGL fractionation plant and the Cochin pipeline.
- On-site staff contacted and informed senior BP safety and operations staff of the situation. BP attempted to reduce the ethane leak by opening up well 103 to the Cochin pipeline. This attempt failed to reduce the release rate.

- BP staff assessed the situation and monitored other plant warning and alarm systems.

7:50 a.m. to 9:10 a.m.

- BP called 911 and the Northeastern Regional Community Awareness and Emergency Response (NR CAER) mutual aid group concerning the ethane release. (Figure 3 shows the members and their respective sites.)

- Alberta Environment (AENV) was called at its 24-hour incident reporting line and advised of the incident. Access roads to and from the plant were secured. The Fort Saskatchewan Fire Department arrived on site at approximately 8:10 a.m.

- Senior BP personnel assessed the situation and monitored the vapour cloud. The master control room at the BP site requested NR CAER (via the Fort Saskatchewan Fire Chief at the roadblocks) to notify Canadian National Railway of the situation.

9:10 a.m. to 9:45 a.m.

- The ethane vapour cloud, or "plume," that had developed from the release enlarged and came into contact with overhead power lines located within the site. Electric arcs from these power lines sparked the plume, creating an explosion and resulting fire. There were no injuries to plant or fire department personnel on site.

- BP began evacuation of plant personnel.

- Fire crews and other emergency response personnel from the City of Fort Saskatchewan were notified about the plume ignition and fire, along with other NR CAER representatives. Emergency response and fire control activities commenced.

Approximately 9:45 a.m. to 10:45 a.m.

- Shortly after the well fires began, the City of Fort Saskatchewan's local emergency response personnel assessed the situation and determined that this emergency was not life threatening and posed no danger to the public.

- The City of Fort Saskatchewan "stood down" its Emergency Operating Centre but continued to deal with a number of inquiries regarding this event through its Protective Services Offices.

- BP contacted Fire Master, a blowout control specialist from Red Deer, and directed it to proceed to the site. BP established further support systems to assist incident management from its office in Calgary.

2.2 Subsequent Developments

With the exceptions of smoke from the fires and a small amount of water runoff, from beginning to end the incident was contained entirely within the BP plant site. In the first 48 hours, black smoke from the fire was significant and observable for many kilometres, but it did not present any danger to the public. However, the black smoke raised concerns among some of the residents of the City of Fort Saskatchewan and the nearby counties of Sturgeon and Strathcona. By August 28, smoke from the well fires was significantly

reduced due to a combination of ongoing fire control efforts and reduced product flow as pressure from the ethane storage cavern declined.

On August 29, a connecting valve between the two wellheads was closed, reducing the fire at the brine well to a 1 m high flame. The fire at the ethane well was also reduced to a 3 to 5 m high flame with no smoke. The fires from both wells continued to burn in a decreasing manner until September 1 in the case of the brine well and September 3 in the case of the product well. In total, it is estimated that about 14 500 m^3 of ethane product was lost during this incident.

In the weeks immediately following, most of the plant and pipeline operations, except those involving the wells, pipelines, and ethane storage cavern associated with the incident, returned to normal. At the time of issuing this report, the ethane storage cavern is out of operation and is to remain so until approval to resume operations is granted by the EUB.

The incident received widespread media coverage due to a number of factors, especially the size of the fire and the resulting black smoke during the first two days. Another factor was the size, type, and location of this facility, which is relatively close to the highly populated area of the City of Fort Saskatchewan.

3 Cavern Storage Operations

To fully understand the BP incident, some background on cavern operations is helpful. Underground caverns are created to store large volumes of hydrocarbons in many places in Alberta and throughout North America. If appropriately designed and managed, cavern storage can be more cost effective, more efficient, and safer than aboveground alternatives.

If underground formations have the appropriate geology, caverns can be created through a process called solution mining. Subsequent to the drilling process, fresh water is circulated through tubing to the bottom of the cavern and then back to the surface to dissolve the surrounding underground salt. Through ongoing circulation, large teardrop-shaped underground caverns can be created.

3.1 Cavern Operations in Fort Saskatchewan

Operational practices used in cavern storage operations are well developed and based on many years of practice. In the Fort Saskatchewan area, the Western Canadian Cavern Operators Group (WCCOG) includes the following members:

Dow Chemical Canada, Inc.
ATCO Pipelines
Canadian Crude Separators
Newalta Corp.
Husky Oil Saskatchewan
BP Canada Energy Company
EnerPro Midstream (A Chevron Company)
The Canadian Salt Company
Williams Energy (Canada) Inc.
TransGas Limited – Saskatchewan
Conoco Canada Limited – Saskatchewan
Albchem
Alberta Energy and Utilities Board

The table below lists the existing cavern storage operations in Fort Saskatchewan.

Cavern Storage Operations Fort Saskatchewan

Company	Number of caverns/type
Dow	7 NGL, 5 ethylene
EnerPro Midstream	10 NGL
BP	10 NGL
Williams Energy	10 NGL
ATCO Pipelines	6 dry gas

3.2 BP Cavern Storage Operations

At BP's NGL plant about 6 kilometres northeast of Fort Saskatchewan, Alberta, there are 10 underground storage caverns, an NGL fractionation plant, and other related equipment and facilities. NGL mix and fractionated products are stored on site and delivered via pipelines to a number of locations in Alberta, eastern Canada, and the United States. As mentioned, this facility plays a significant role in the Alberta NGL pipeline network (see Figure 4).

Within the plant site, one of the underground storage caverns, cavern 103, is used for the storage of ethane, an NGL product with many uses in the petrochemical industry. Wellhead and equipment configurations associated with this storage facility include a 2-inch connecting line between two wells located above the cavern.

These wells, wells 103 (ethane product) and 103A (brine), were designed to be able to both produce and inject their respective fluids. Within the storage cavern, the ethane does not mix with the brine water but settles on the upper layer, similar to typical "oil on water" fluid mixtures. In addition to achieving the desired separation, the salt content in the brine water also prevents undue erosion of the inside of the cavern walls. By coordinating well 103 and 103A production and injection operations, the ethane storage cavern levels can be adjusted to store and/or produce ethane for disposition to market.

BP ethane cavern 103 was completed in the Lotsberg Salt Formation at a depth of about 1850 m and has a capacity to hold about 127 thousand cubic metres (10^3 m^3) of product. At the time of the incident, there were approximately 76 10^3 m^3 of ethane in the cavern.

During the August 26 incident, downhole pressure dropped from 20 700 to 4400 kilopascals (kPa) over a period of six days. The magnitude of the change in operating pressure of cavern 103 and the speed n the pressure change that occurred may have caused damage to the cavern. Cavern 103 has been emptied and now shows some signs of communication with an adjacent cavern on the BP site.

BP is working with Sandia National Laboratories of New Mexico (Sandia) to develop models describing the stress-strain behaviour of the Lotsberg Salt Formation. This work will be used to help identify conditions that could lead to cavern failure. The Sandia work should also aid in evaluating potential damage to cavern 103 and adjacent caverns. Information gained may aid in developing improved guidelines for normal operating pressure ranges and maximum stress as a function of time for the Lotsberg Salt Formation. BP is committed to sharing these results with the regulators and industry. Work should be complete in the second quarter of 2002.

Storage operations in cavern 103 will not resume until BP has EUB approval. BP must demonstrate to the satisfaction of the EUB that integrity of the caverns and wellbore exists through integrity testing as per the standards set out in *CSA Z341-98*. BP is required to provide the EUB with a copy of the integrity testing results and the Sandia work, when completed, along with recommendations regarding normal operating pressure ranges and maximum deviations as a function of time. Furthermore, the EUB expects BP to honour its commitment to share this work with the industry.

4 Issues

4.1 Failure Mechanism

The failure that resulted in the ethane release occurred on a 2-inch forged elbow installed in 1977 on the line connecting two wellheads that service cavern 103. This equalization line was used during well servicing operations and was not necessary for the day-to-day cavern operations. The failure originated on the exterior surface located near the centre line of the inside radius of the bend. The fracture plane was oriented on a transverse plane at approximately the midpoint of the bend. The orientation of the fracture surface indicates that the main stress, or stresses, creating the failure were axial, or longitudinal, in nature. The metallurgical investigation conducted by an independent consulting firm showed that the failed elbow would satisfy the physical and metallurgical requirements of the original material-manufacturing standard. However, the metallurgical investigation revealed numerous forging defects at the origin region on the exterior surface of the inside bend radius.

The consultant concluded that the forging defects, referred to as forging laps, existed from the time of manufacture and that the orientation of the forging laps would create planes of weakness and act as local stress concentrations for the axial component of any applied or residual stresses. An analysis performed by the consultant showed that the stress fields created by the internal pressure and induced moments were low and would be of no consequence in the initiation of the failure if acting upon sound elbow material either alone or in concert and that the presence of the forging lap defects was required for failure. No cracking or forging laps were found on the metallographic specimens examined from the other forged elbows on this cross-over or forged elbows removed from the cavern 106 cross-over. The EUB is satisfied that unusual transverse forging defects caused the elbow to fail. These defects would not be detectable through conventional testing methods. The EUB notes that in March 2000 BP conducted ultrasonic thickness measurements of all brine and product piping and in May 2000 successfully hydrostatically pressure-tested the cross-over piping to twice the normal operating pressure present at the time of failure.

4.2 Notification

The EUB believes that BP and the City of Fort Saskatchewan understood and met their emergency response responsibilities. However, the EUB also believes that early public notification by BP did not meet public expectations. In addition, a question arose as to whether BP should have notified the EUB rather than AENV, according to the EUB *Informational Letter (IL) 98-1: A Memorandum of Understanding between Alberta Environmental Protection and the Alberta Energy and Utilities Board Regarding*

Coordination of Release Notification Requirements and Subsequent Regulatory Response.[*]

Notification to the Public

When the accidental ignition of the ethane plume on the morning of August 26 resulted in a significant amount of black smoke from the fire, highly visible for quite a distance, residents in the surrounding areas began to make inquiries to local authorities as to the cause.

BP did not set up an information line or issue any news releases in the first few hours of the incident on August 26 to inform the public of the situation. In addition, BP did not issue a COMM-ALERT—a local communications protocol and system developed to inform local residents of events—until approximately 5:00 p.m. on August 26. It is clear from feedback obtained through public meetings BP later hosted that public notification at the start of the incident did not meet expectations.

At 10:15 a.m., the RCMP issued a news release to the local media announcing that a gas release had been reported. The news release advised area residents to stay within their residences as a preventive measure and to address inquiries to the Fort Saskatchewan RCMP Detachment. This news release prompted other inquiries.

Following August 26 and for the duration of the incident, BP established a 24-hour information phone line, issued daily COMM-ALERT messages and daily news releases, organized a number of town hall meetings, and opened a public information centre in a local hotel. These various BP initiatives provided the means for local residents to be fully informed and updated about the incident.

The EUB acknowledges the communication efforts undertaken by BP to engage members of the public and other stakeholders in the days immediately following August 26. Ultimately this has helped contribute to ongoing dialogues aimed at improving existing communication protocols in the area. The EUB believes that some improvements to early communication processes involving local residents are warranted in any future responses from BP or other operators in the area concerning an incident of similar high visibility. These would primarily be aimed at better informing those in the surrounding area as quickly as possible after an incident has occurred, thereby helping to reduce concerns of local area residents and other members of the public.

One organization that is anticipated to assist in the development of improved incident communication in the Fort Saskatchewan area is the Northeast Capital Industrial Association (NCIA). The NCIA describes itself as a nonprofit cooperative that seeks to understand and reduce the environmental impacts of member industries (operating in the Northeast Capital Region) through collaborative efforts with the community and all levels of government, while supporting sustainable growth.

NCIA has a number of objectives, including

- to engage the community in the understanding of, and response to, regional environment, health, and safety concerns, and

[*] *IL 98-1* is available on the EUB Web site <www.eub.gov.ab.ca> and from EUB Information Services, Main Floor, 640 – 5 Avenue SW, Calgary, Alberta, telephone (403) 297-7040.

- to work with government at any level respecting environment, health, and safety matters that are of mutual member interest in the development of policies, regulations, and legislation.

The City of Fort Saskatchewan and the NCIA have been involved in various discussions aimed at furthering a more comprehensive and integrated response approach for the industrial operators in the area. The EUB supports these efforts and encourages NCIA, operators, and other stakeholder groups in the area to continue to work with the City of Fort Saskatchewan and other local authorities in developing a better public notification protocol and system.

Notification to the EUB

BP notified AENV at 7:51 a.m. The EUB St. Albert Field Centre was notified at 1:00 p.m. *IL 98-1* describes a reporting process that addresses the needs of both agencies while providing the upstream oil and gas industry with a single-call process to report releases.

BP has stated that it was its understanding of *IL 98-1* that AENV would contact the EUB with respect to the ethane release.

The EUB notes that Attachment 1 of *IL 98-1* (see Appendix 1) outlines industry notification requirements and indicates that for jointly approved AENV/EUB facilities, if an event is identified as "Blowouts/Pipeline Failures/Sour Gas Releases/Fires," the EUB should be the primary contact. This IL gives examples of unrefined product releases (e.g., crude oil, LPG, diluent, condensate, synthetic oil, sour gas, produced water, and other produced fluids) and refined product releases (diesel, gasoline, sulphur, and solvents). It is the EUB's view that *IL 98-1* is relatively clear that in the event of a fire at a jointly approved EUB/AENV facility, the EUB should be the primary contact and would, in turn, notify AENV. The EUB acknowledges BP's commitment to update its emergency response plan to reflect the appropriate EUB telephone contact in the immediate emergency call-down process.

As noted in Section 5 of *IL 98-1*, AENV and the EUB will assist each other in responding to nonroutine situations. The EUB has had communications with AENV following this incident to ensure that in the event that jointly approved facilities experience a significant release, the other agency will be notified in an appropriate time period with regard for the severity of the release.

4.3 Public Safety

In assessing public safety issues in relation to this incident, the EUB notes that throughout the incident the fire was contained entirely on site. There were no injuries to workers or members of the public and, outside of the plant site itself, no property damage. The EUB concludes that there was no threat to public safety.

4.4 Ethane Plume Ignition

The accidental ignition of the ethane plume prompted the EUB to review BP's ignition policy in place at the time of the incident (see Appendix 2). The EUB found that the existing policy overly relied on the judgement of the senior operator, who had the authority to ignite an uncontrolled product leak. As a result of this review, the EUB believes that the ignition criteria and parameters need to be more clearly defined. Using

the existing policy, it is not clear how one would determine whether the above criteria were met.

The EUB notes the following:

- The time between the identification of the ethane plume and ignition was approximately two hours.
- When the emergency shutdown (ESD) valve on the well was activated around 7:10 a.m., the vapour cloud did not disperse.
- An unsuccessful attempt was made at 7:20 a.m. to draw pressure down on well 103 and reduce the flow to the vapour cloud by opening the well to the Cochin pipeline. There was no evidence of other strategies being actively pursued that would reduce the flow of fuel to the vapour cloud.
- During the two-hour period, the vapour plume grew to a size such that personnel would not be expected to get close enough to properly assess the situation.

Ignition criteria should be clear and sufficiently detailed so that the responsible individual does not have to exercise considerable judgement about when ignition is required. BP's ignition criteria required interpretation and considerable judgement that would be subject to question. Given this, it would be unfair to expect an individual to make the decision to ignite the vapour cloud with these procedures.

The EUB concludes that BP's ignition policy at the site was inadequate to effectively address the ethane release that occurred. To address this specific issue, BP must provide the EUB with updated ignition procedures and criteria within three months of the issuance of this report.

To address this issue more broadly on an industry-wide basis, an EUB-approved emergency response plan will be required for all NGL cavern storage facilities. Each plan should include clear ignition criteria. The EUB intends to pursue this requirement through regulatory changes, preceded by consultations with appropriate public parties, government agencies, and industry.

4.5 Environment

From early in the incident, officials from the EUB and AENV worked closely with local authorities and BP staff to coordinate actions and expedite well control operations. Air and water monitoring stations were put in place in the area. Units were employed that continually monitored air samples for total hydrocarbons and particulate matter downwind of the ethane fire, upwind, and at residences where individuals indicated a concern about air quality.

During the incident (August 26 to September 3), AENV monitored ambient air quality off site in the vicinity of the fire with its mobile air monitoring laboratory, as well as at its permanent stations. BP also conducted mobile monitoring. The air quality parameters that were measured included hydrocarbons, particulates, oxides of nitrogen, carbon monoxide, ozone, sulphur dioxide, hydrogen sulphide, total reduced sulphur, and ammonia. Maximum air quality levels in the Fort Saskatchewan area remained well below Alberta's ambient air quality guidelines during this event.

Fine particulate levels PM 2.5 (airborne particles that are 2.5 microns or less in diameter) remained low throughout the period: the maximum 1-hour concentration was 26 micrograms per cubic metre, well below the 24-hour Canada-wide standard of 30 micrograms per cubic metre.

Within the first 48 hours of the incident, significant progress was made in fire and incident control, so that smoke from the fire was largely removed and the flames were significantly reduced in size. However, the fire could not be safely extinguished unless the ethane product flowing from the damaged wells could be shut off. Therefore, plans to completely extinguish the fire after that time were based on ensuring appropriate and safe coordination of fire control initiatives with well control efforts on the cavern wells.

Surface water runoff and freshwater sources were used to assist in fire control efforts. The fire generated enough heat to cause a failure of the brine piping at wellhead103, which caused a small amount (3 to 4 m^3) of brine water to be released from the site. In the initial fire control effort, some water with slightly elevated chloride concentrations entered the North Saskatchewan River. However, downstream monitoring by AENV indicated that there was no adverse effect as a result of this release. Appropriate containment and recycling of water runoff was achieved on August 27. This prevented any further runoff to the North Saskatchewan River for the remainder of the incident.

4.6 Impact on Industry Activities

The combination of the uncontrolled fire and the BP facility's location resulted in a number of NGL pipelines being shut in. The incident affected both upstream gas plants that produce NGLs and rely on the pipelines to transport them and downstream petrochemical plants that rely on the pipelines for delivery of NGL feedstocks (see Figure 4 for pipelines and associated locations connected with the BP site). Despite these impacts, the EUB believes that while the effects of the cavern 103 well fires were acute in the days immediately following August 26, they were not of lasting significance.

In the NGL industry, there is a clear relationship among production capabilities, pipeline delivery practices, and on-site storage options. The Alberta petroleum industry cooperated in dealing with these NGL storage pressures in a number of ways. Some gas plants trucked NGL products to alternative storage sites, while others received permission from major natural gas pipelines to add safe levels of NGL product to specific natural gas streams.

The EUB finds that the measures taken to minimize the effects on oil and gas operations from the incident were appropriate. By mid-September, normal pipeline operations both upstream and downstream of the facility had resumed, with the exception of those operations directly dependent on dispositions to and from cavern 103.

5 Conclusions

The EUB reviewed the facts related to the incident and arrived at the following conclusions. Section 6 details the actions already taken and to be taken to prevent a recurrence.

- The cause of the incident was the failure of an elbow of a 2-inch line connecting two wellheads that service the ethane storage cavern. The EUB is satisfied that unusual

transverse forging defects caused the elbow to fail. These defects would not be detectable through conventional testing methods.

- The failure of the elbow resulted in ethane product being released to atmosphere, creating an ethane vapour "plume" that ignited through contact with overhead power lines located on the plant site.

- It is the EUB's view that the 2-inch pressure equalization line connecting the two wellheads was not necessary for the day-to-day cavern operations.

- Although there was significant smoke from the storage cavern well fires, particularly in the first 48 hours after ignition, the fire was contained entirely on site and there was no threat to public safety. There were no injuries to members of the public, no injuries to incident response personnel (except for a minor injury, a cut finger), and no property damage outside of the plant site itself.

- BP and the City of Fort Saskatchewan understood and met their emergency response responsibilities. However, early public notification by BP did not meet public expectations.

- Environmental impacts of the incident were primarily emissions of soot and other particulate matter from the fires in the early stages. In addition, a small release of brine (salt) water into the North Saskatchewan River occurred during early fire control efforts.

- BP's ignition policy at this site was inadequate to effectively address the decision-making criteria to ignite an NGL release.

- The measures taken by BP and affected industries to minimize the effects of the incident on industry operations were appropriate.

6 Actions

- BP has eliminated the 2-inch line between wells 103 and 103A. A similar line on BP cavern 106 has also been taken out of service.

- As a result of this incident, the EUB requires that BP ensure that all permanent wellhead hydrocarbon, brine, and water lines on its Alberta NGL caverns are equipped with ESDs. BP must report to the EUB within six months from the issuance of this report to confirm that this action has been taken.

- An EUB-approved emergency response plan will be required for all NGL cavern storage facilities. Each plan should include clear ignition criteria. The EUB intends to pursue this requirement through regulatory changes, preceded by consultations with appropriate public parties, government agencies, and industry.

- BP must provide the EUB with updated ignition criteria and procedures for ignition within three months of the issuance of this report.

- BP, in cooperation with the Northeast Capital Industrial Association (NCIA) and other stakeholders in the area, will continue to work with the City of Fort

Saskatchewan and other local authorities to develop a better public notification protocol system.

- The magnitude of the change in operating pressure of cavern 103 and the speed in the pressure change that occurred may have caused damage to the cavern. BP is working with Sandia National Laboratories of New Mexico to develop models describing the stress-strain behaviour of the Lotsberg Salt Formation. BP has committed to share the results with industry.

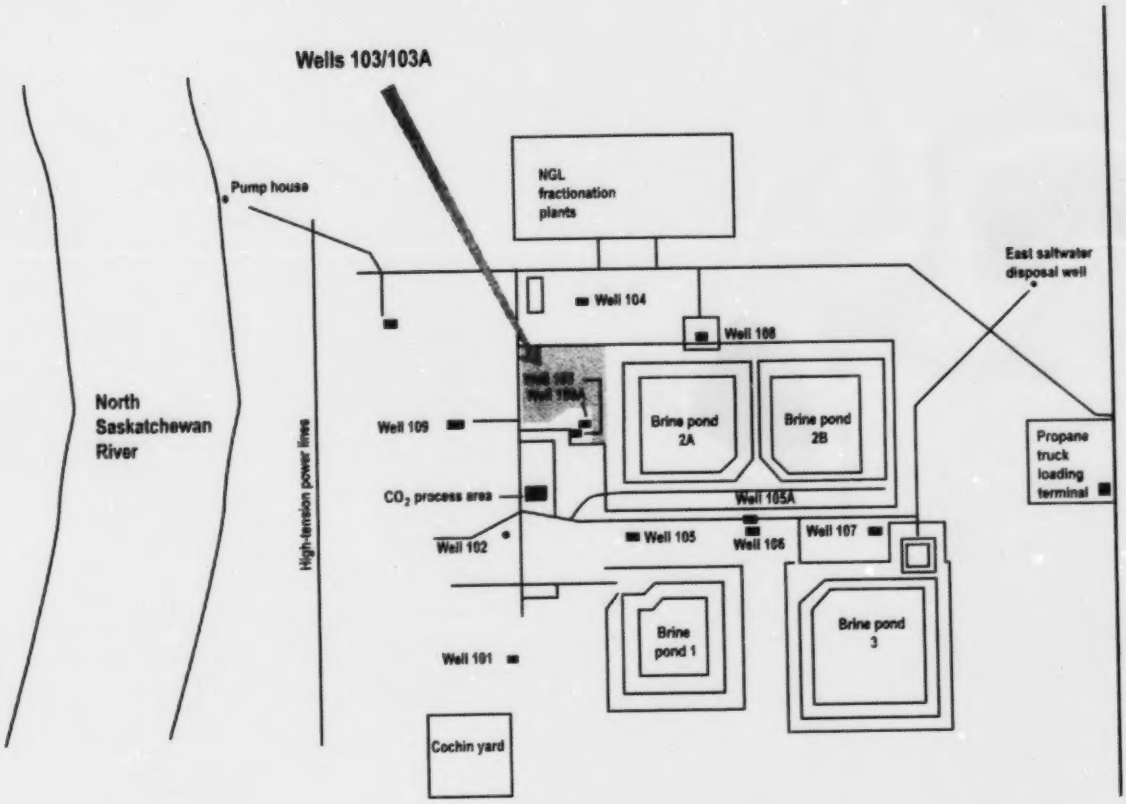

Figure 1. BP Fort Saskatchewan NGL facility

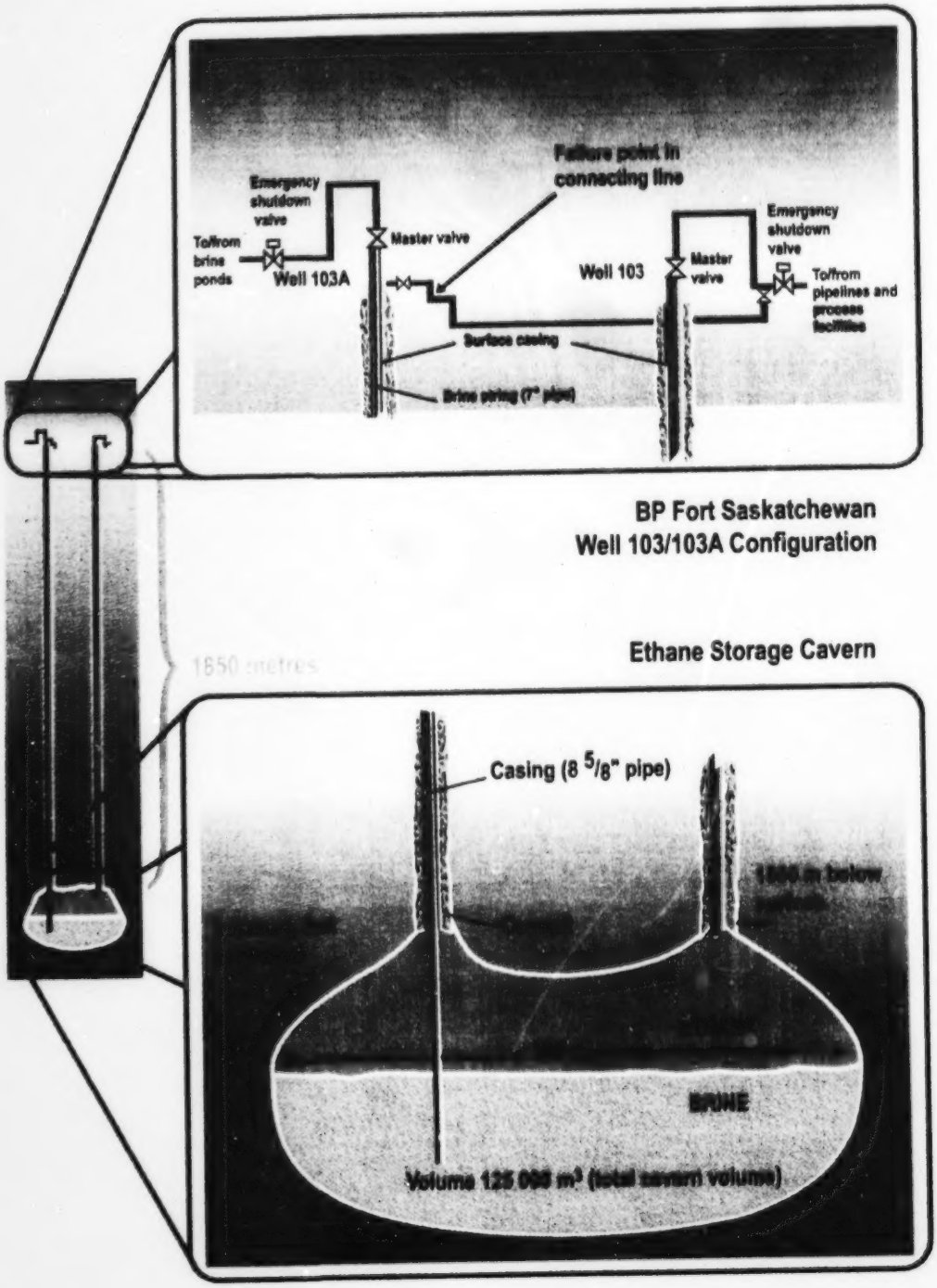

Figure 2. Failure point in connecting line and cross-section of cavern operations

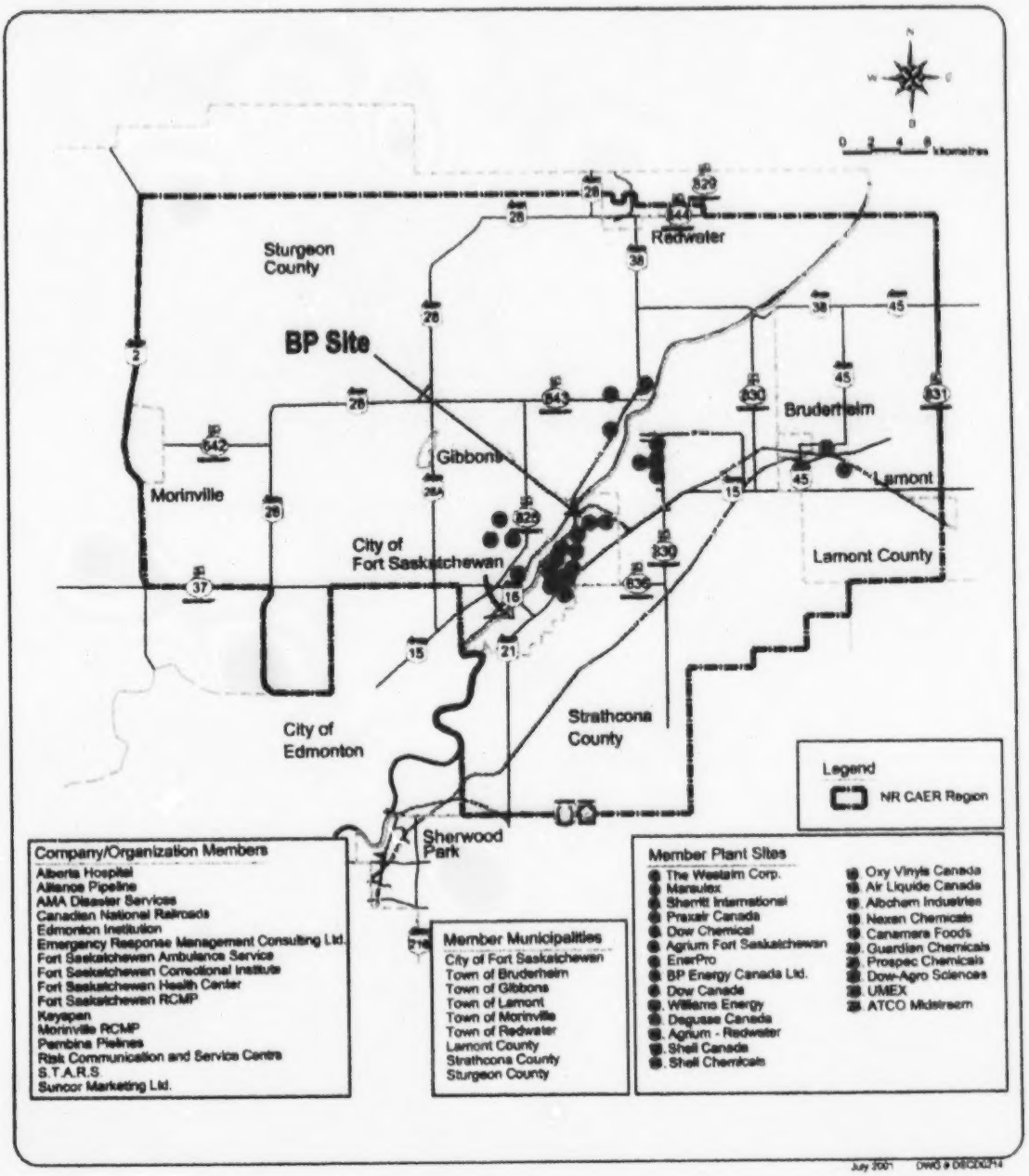

Figure 3. Northeastern Regional Community Awareness and Emergency Response Group

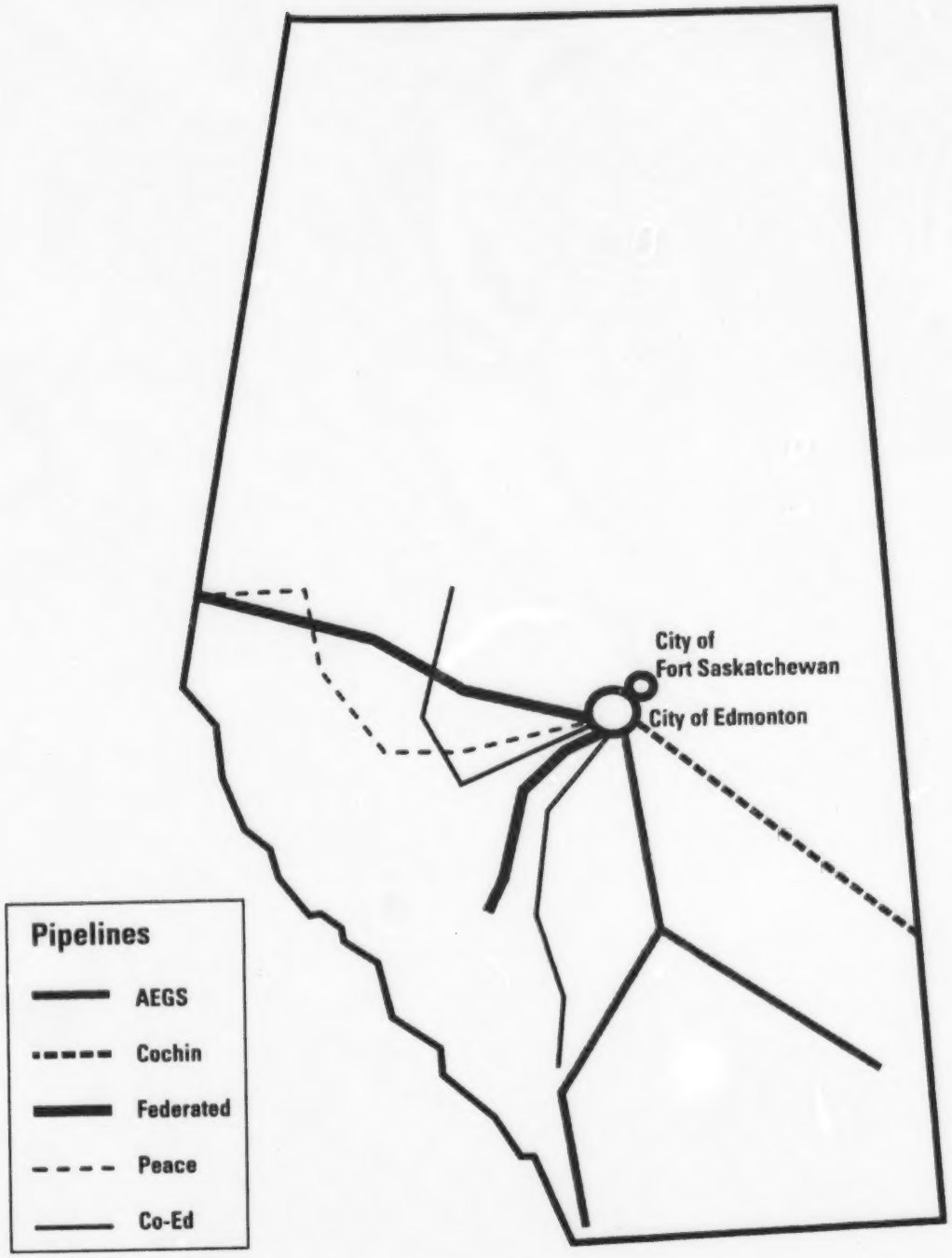

Figure 4. Pipelines connected to BP Fort Saskatchewan NGL facility

Appendix 1 Attachment I to Informational Letter (IL) 98-1

ATTACHMENT I: INDUSTRY NOTIFICATION REQUIREMENTS JOINT AEP/EUB APPROVED FACILITY OR PIPELINE

Facility Type Locations	Event		Primary Contact	Phone Numbers
_____	1	SPILL/RELEASES/CUMULATIVE RELEASES		
_____	1.1	Unrefined product spill (e.g., liquid hydrocarbon or produced water)	EUB	Local field centre (see reverse side)
_____	1.2	Refined product spill	AEP	422-4505
_____	1.3	Contravention of AEP approvals	AEP	422-4505
_____	1.4	Unplanned or planned releases in accordance with EUB approvals	EUB	Local field centre (see reverse side)
_____	2	UNSCHEDULED/EMERGENCY FLARING		
		For flaring resulting in one or more of the following, contact the most appropriate organization and request referral.		
_____	2.1	Exceed AEP approval conditions	AEP	422-4205
_____	2.2	Exceed EUB approved volume or greater that 24 hours in duration	EUB	Local field centre (see reverse side)
_____	2.3	Black smoke or potential adverse conditions (e.g., public complaints)	AEP	422-4205
_____	3	ODOURS/FUGITIVE EMISSIONS		
_____	3.1	From unrefined products	EUB	Local field centre (see reverse side)
_____	3.2	From refined products	AEP	422-4505
_____	3.3	Sulphur dust/fires	AEP	422-4505
	4	EMERGENCY RESPONSE		
(For use by industry to identify the type and location of facilities)	4.1	Blowouts/Pipeline Failures/Sour Gas Releases/Fires	EUB	Local field centre (see reverse side)

EUB ONLY APPROVED FACILITY OR PIPELINE

Facility Type Location(s)	Event		Primary Contact	Phone Numbers
_____	1	SPILL/RELEASES/CUMULATIVE RELEASES		
_____	1.1	Unrefined product spill (e.g., liquid hydrocarbon or produced water)	EUB	Local field centre (see reverse side)
_____	1.2	Unplanned or planned releases in accordance with EUB approvals	EUB	Local area office (see reverse side)
_____	1.3	Refined product spill	AEP	422-4505
_____	2	UNSCHEDULED/EMERGENCY FLARING		
_____	2.1	Exceed EUB approved volume limits or greater than 24 hours in duration	EUB	Local field centre (see reverse side)
_____	2.2	Black smoke or potential adverse conditions (e.g., public complaints)	EUB	Local field centre (see reverse side)
_____	3	ODOURS/FUGITIVE EMISSIONS		
_____	3.1	From refined/unrefined products	EUB	Local field centre (see reverse side)
	4	EMERGENCY RESPONSE		
(For use by industry to identify the type and location of facilities)	4.1	Blowouts/Pipeline Failures/Sour Gas Releases/Fires	EUB	Local field centre (see reverse side)

NOTE: When circumstances require notification to AEP's Pollution Control Division and the EUB's Facilities Division, the initial organization contacted will notify the other.

Appendix 2 BP Ignition Criteria

Excerpted from BP's "Fort Saskatchewan Terminal Cavern Emergency Procedures":

3.3 **Authority for Emergency Ignition of an Uncontrollable Continuous Product Leak.**

If large volumes of product are escaping from a cavern wellhead and there is no reasonable chance of containing the product, the following steps should be followed by the senior site operator.

3.3.1 The senior Fort Saskatchewan operator has the authority to ignite large uncontrollable releases of product when the Area Superintendent or Foreman are not on site and in the Senior Operators opinion:

a) Further product release cannot be contained.
b) Further product release constitutes an immediate hazard to the surrounding area and communities.
c) Potential hazard would be increased by waiting to attempt communication with the Area Superintendent or Area Foreman for permission to ignite the product leak.

3.3.2 Before ignition is attempted all site plants and pipelines must be put into emergency shut down and all operating personnel evacuated to a safe distance from the cavern. All non-essential personnel should continue evacuation to the Fort Saskatchewan Emergency Evacuation Centre.

3.3.3 The senior operator must evacuate with the Control Room Emergency Briefcase which will contain a flare pistol, flares, portable emergency cellular telephones and emergency instructions and contact lists.

3.3.4 Ignition must be attempted from a safe distance and in a gas free area which the shooter is protected by an earthen structure such as a brine pond berm or a drainage ditch. Remember once a product leak is ignited, it may cause an explosion and will develop flame radiation, so the more distance from the product leak the better.

3.3.5 Once ignition is complete, use the cellular telephone to contact all authorities and contact on the emergency phone contact list as attached.